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(54) **Electrical connector and method of manufacture.**

(57) An electrical connector (10) for interconnection of circuit boards (12, 14) in sandwich fashion comprises a contact element (18) embedded between layers (20) of elastomeric material. The element comprises S-shaped portions extending from opposite sides of a central bight, with free ends having contact extensions (32) exposed at opposite sides of the elastomeric body formed by the layers (20). In a method of manufacture a series of elements (18) is formed as a ladder strip including a carrier portion which is fed between strips of elastomer (20) which are bonded together before the carrier is severed.

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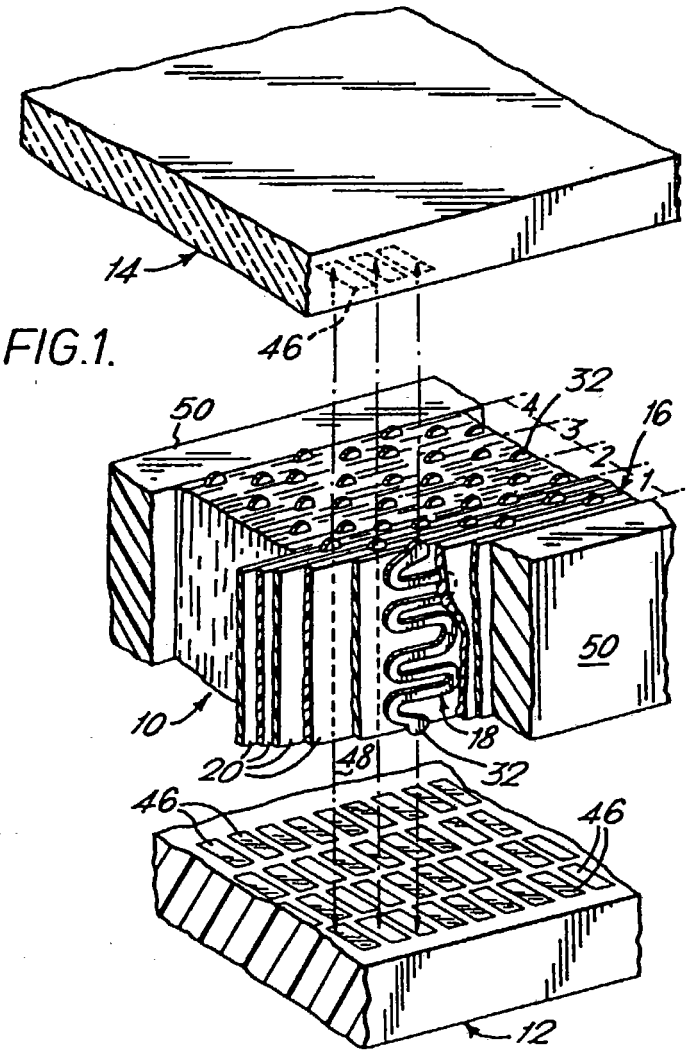


FIG.1.

Electrical Connector and Method of Manufacture.

This invention relates to electrical connectors for interconnecting spaced printed circuit boards and comprising a conductive connecting spring element having contacts at opposite ends and embedded in elastomeric material with the contacts exposed at opposite surfaces of the elastomeric material. The invention also relates to the method of manufacture of such a connector.

Connectors of this kind have been proposed, for example, in US patents 3,795,037, 3,795,884 and 4,016,647.

It is an object of the invention to provide a connector capable of operating with low contact resistance and capable of withstanding shock, particularly thermal shock without loss of contact integrity.

In a connector of the kind specified according to the invention the connecting element comprises two generally S-shaped spring portions extending from a central bight, free ends of the spring portions having extensions defining the contacts, the element being embedded between layers of elastomeric material with the contacts exposed at opposite sides of the resultant elastomeric body.

A method of making such a connector comprises forming a series of contact elements from sheet metal to extend laterally from an integral carrier rail, embedding the series of contact elements between layers of elastomeric material with the contacts and the carrier rail exposed, and severing the carrier rail from the elements.

The invention will now be described, by way of

example, with reference to the accompanying partly diagrammatic drawings, in which:-

Figure 1 is a perspective fragmentary, partially sectional exploded view of a connector sandwiched between two circuit boards;

Figure 2 is a perspective fragmentary view of a strip of connecting elements in a preliminary stage of manufacture of the connector of Fig.1;

Figure 3 is a schematic view illustrating a step in the manufacture of the connector of Fig.1;

Figure 4 is a fragmentary perspective view of the strip of connecting elements embedded between strips of elastomeric material during an intermediate step in the manufacture of the connector;

Figure 5 is a side elevation of a modified connecting element, and

Figure 6 is a fragmentary, perspective exploded view of an alternative connector assembly.

The assembly of Figure 1 comprises a connector 10 positioned in sandwich fashion between upper and lower circuit boards 14, 12. The connector 10 comprises a stack of composite laminates 16 stacked in side by side fashion and clamped together between end walls 50. Each laminate 16 comprises an evenly spaced series of connecting elements 18 embedded between two layers 20 of elastomeric material, and is of strip-like form with contact portions 32 of the contact elements 18 projecting from opposite sides of the strip, and from upper and lower surfaces of the elastomeric body defined by the stack of laminates.

Each connecting element 18 comprises an elongated sinuous spring form 26, as seen more clearly in Figure 2, consisting of two S-shaped portions 28 extending from opposite sides of a central bight 30 of larger curvature than smaller bights separating limbs of the S-shaped portions 28 which extend in generally spaced parallel

coplanar relation. Free ends of the S-shaped portions 28 are formed with extensions at bights 34 outwardly inclined to terminate at oppositely directed contact portions 32 disposed centrally of the width of contact element 18.

In the modified contact element of Figure 5, the contacts 32 are connected by a short-circuit wire, welded at its ends to the contact portions 32 and adapted to provide a shorter, lower impedance, circuit path between the contacts.

Referring back to Figure 1, the laminates 16 are arranged in groups 1 to 4, each group comprising three laminates secured together with the contact portions 32 of each laminate staggered lengthwise of the strip like laminates in relation to the contact portions of the other strips of the group, so that, as indicated by arrows 48 each contact 32 is adapted to engage a different circuit pad 46 on the circuit boards 12, 14. The groups 1 to 4 are suitably relatively positioned in relation to the pattern of circuit pads 46, to enable interconnection of complementary circuit pads 46 of respective boards 12, 14.

As shown in Figure 2, the contact elements 18 are suitably stamped and formed from sheet metal in ladder strip form 21, with a series of elements 18 extending between a pair of carrier rails 22 integrally connected to the contact extensions by severable links 24. The links extend from the bights 34, remote from the contact portions 32, and are inclined away from the contact portions 32. The ladder strip 21 may be of indefinite length, and wound upon a reel to facilitate handling during manufacture of the connector as described below. Suitable metals are stainless steel, plated spring steel and beryllium copper.

In the method of manufacture schematically illustrated in Figure 3, a continuous strip 45 of laminate for cutting into individual composite laminates 16 is prepared from a reel 38 of ladder strip 21 of connecting

elements 18 and two reels 42 of strip-form elastomeric material 20.

The strip 21 is fed through a welding station 40 where, if desired, short circuit wires are welded between the contacts 32 of each element 18, according to the Figure 5 embodiment. The strips 20 of elastomeric material are fed to opposite sides of the strip 21 to form a composite strip 20, 21, 20 which passes through a bonding station 44 where the strips 20 are bonded together to embed the contact elements 18, as shown in Figure 4, with the carrier rails 22 spaced from marginal portions of the strips 20, and with the contacts 32, and portions of the links 24 exposed. The composite strip 45 is then suitably fed through a severing and cutting station, not shown, where the links 24 are severed adjacent the margins of the elastomeric strips 20, and desired lengths of laminate 16 are cut from the continuous strip 45. The lengths of laminate 16 may then be stacked to form the assembly of Figure 1.

Alternatively, as shown in Figure 6, a connector assembly 52 comprises laminates 16, each cut from the continuous strip 45 to include a single contact element 18, and the laminates being stacked to form a connector assembly with a single row of contact elements 18, defining a row of contacts 32 at opposite sides.

Various elastomeric materials may be used for the strips 20 to form the composite laminate 16, for example polyurethane rubber. The elastic characteristics of the material will influence the spring characteristics of the contact elements 18. In the process of bonding the elastomeric strips about the contact elements, the material may be caused to flow, for example if the material is thermoplastic, so that the contact elements are contained in an elastomeric body without voids. Alternatively the strips 20 may be bonded to define pockets within which the

elements 18 are contained. The latter structure allows for flexure of the spring elements 18 independently of the elastomeric material.

Claims:-

1. An electrical connector for interconnection of spaced circuit boards in sandwich fashion and comprising a spring contact element embedded in a body of elastomeric material with contact portions exposed at opposite surfaces of the body, characterised in that the contact element (18) comprises two S-shaped portions (28) projecting from opposite sides of a central bight (30) and embedded between layers (20) of elastomeric material, free ends of the S-shaped portions having extensions defining the contact portions (32).

2. A connector as claimed in claim 1 characterised in that a short circuit wire (36) is welded to and extends between the contact extensions (32) to present a lower impedance path than that of the S-shaped portions (28).

3. A connector as claimed in claim 1 or in claim 2, characterised in that a series of contact elements (28) is disposed in a strip-like laminate (16) of elastomeric layers (26) on opposite sides.

4. A connector as claimed in claim 3, characterised in that a plurality of strip-like laminates (16) is arranged in a stack of laminates (16) in side by side relation.

5. A method of making a connector as claimed in claim 1 characterised by forming a series of contact elements (18) from sheet metal to extend laterally from an integral carrier rail (22), embedding the contact elements (18) between layers of elastomeric material with the contact portions (32) and the carrier rail (22) exposed, and severing the carrier rail from the contact elements.

6. A method as claimed in claim 5, characterised in that after forming the series of contact elements contact portions (32) of each contact element are interconnected by a short circuit wire (36) welded at each end to the contact portions (32).

7. A method as claimed in claim 5 characterised in

that a continuous length of strip-like laminate of the series of connector elements (18) embedded between the layers (20) of elastomeric material is cut into lengths (16) which are stacked in side-by-side relationship.

AMENDED CLAIMS

Claims:-

1. An electrical connector (10) for interconnection of spaced circuit boards (12,14) in sandwiched fashion, and comprising a multiplicity of spaced spring contact elements (18) mounted in an insulating body with contact portions (32) of each element (18) being exposed at opposite surfaces of the body, each contact element (18) having resilient limbs, characterised in that limbs of each contact element (18) extend in generally complanar fashion and the elements (18) are embedded between strip-like layers (20) of elastomeric material with the contact portions (32) projecting from opposite sides of the strips (20) which are bonded together to define a laminate (16) having pockets within which the contact elements (18) are contained, a series of laminates (16) being stacked in side by side fashion to define the connector.

2. A connector as claimed in claim 1 characterised in that a short circuit wire (36) is welded to and extends between the contact extensions (32) to present a lower impedance path than that of the limbs (28).

3. A connector as claimed in claim 1 or in claim 2, characterised in that a series of contact elements (28) is disposed in a strip-like laminate (16) of elastomeric layers (26) on opposite sides.

4. A method of making a connector as claimed in claim 1 characterised by forming a series of contact elements (18) from sheet metal to extend laterally from an integral carrier rail (22), embedding the contact elements (18) between layers of elastomeric material with the contact portions (32) and the carrier rail (22) exposed, bonding layers together to define pockets containing the elements, and severing the carrier rail from the contact elements.

5. A method as claimed in claim 4, characterised in that after forming the series of contact elements contact portions (32) of each contact element are interconnected

by a short circuit wire (36) welded at each end to the contact portions (32).

6. A method as claimed in claim 4 characterised in that a continuous length of strip-like laminate of the series of connector elements (18) embedded between the layers (20) of elastomeric material is cut into lengths (16) which are stacked in side by side relationship.

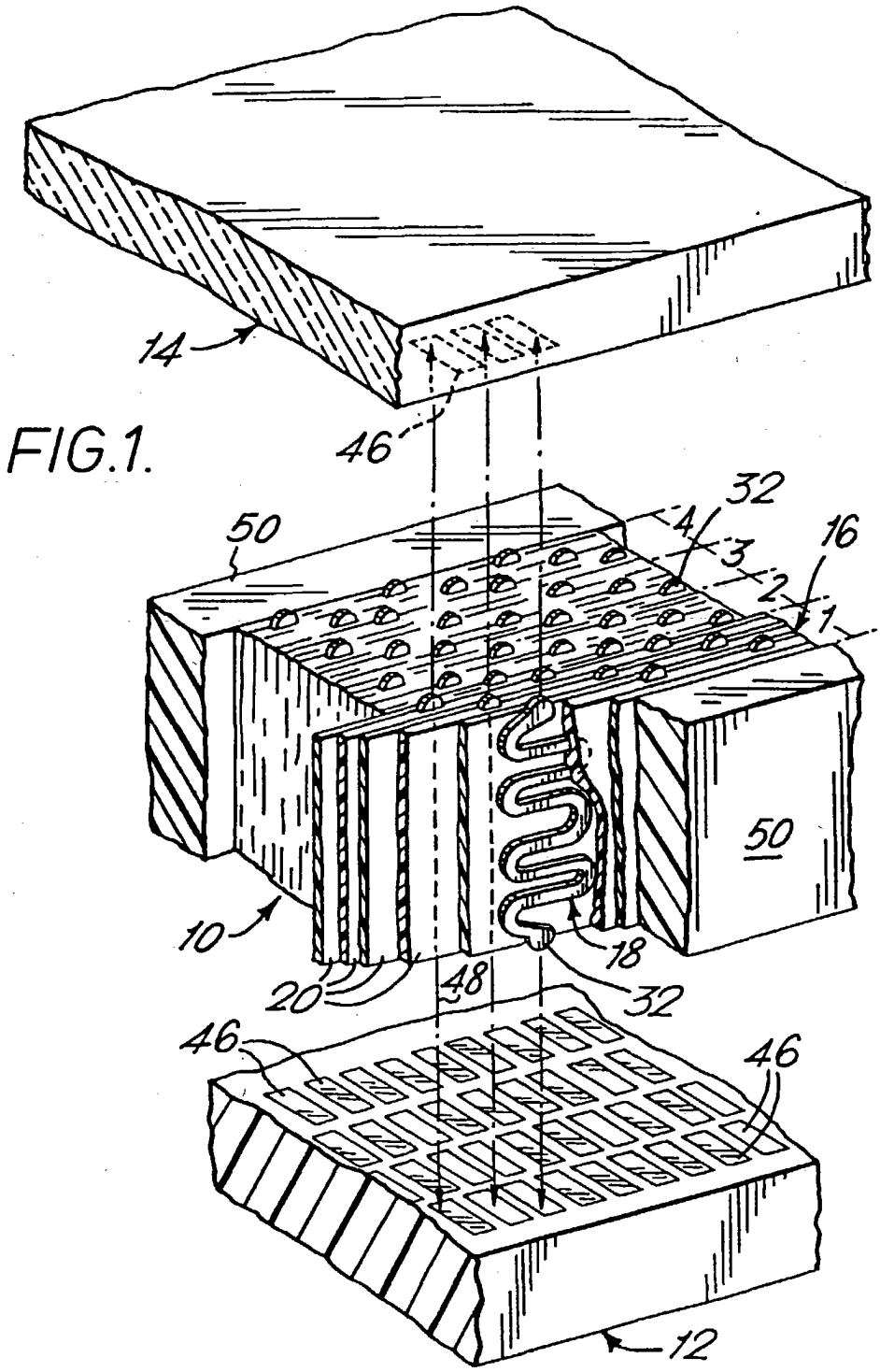


FIG.1.

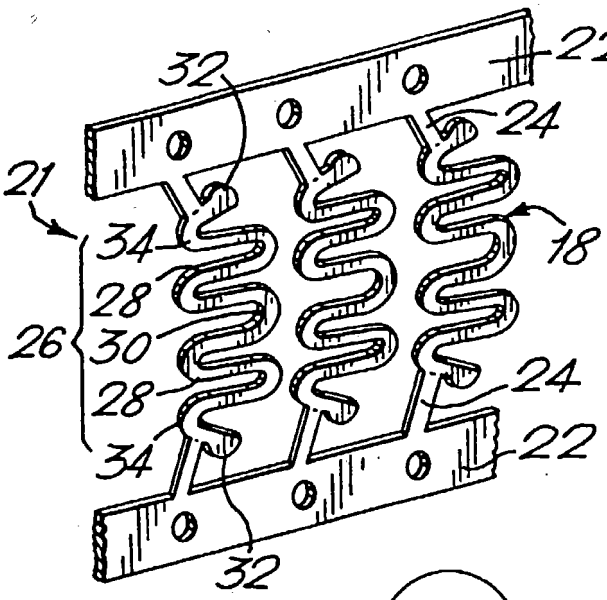
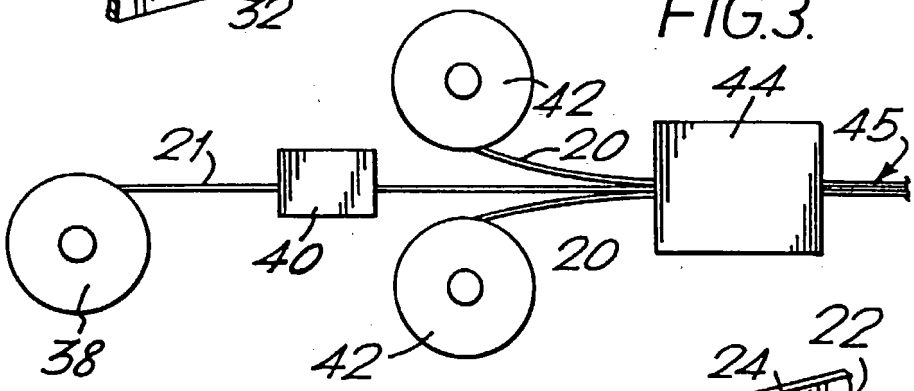


FIG.2.

FIG.3.



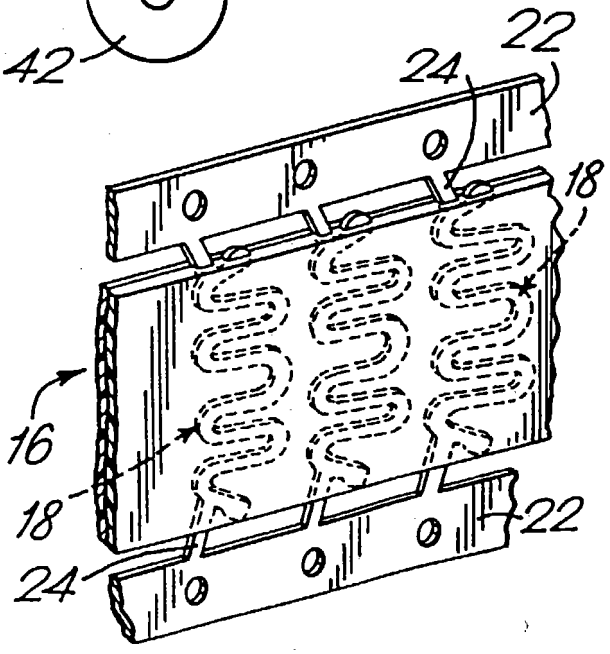
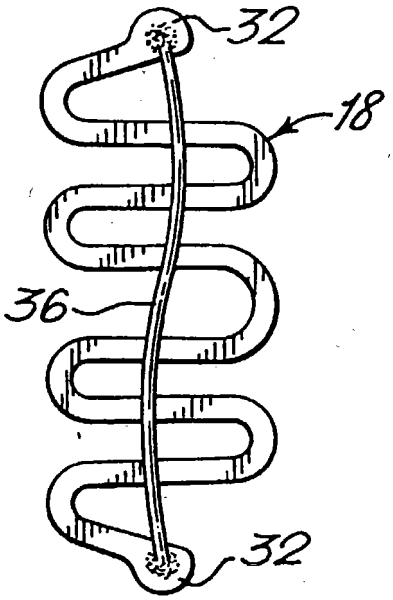


FIG.4.

FIG.5.



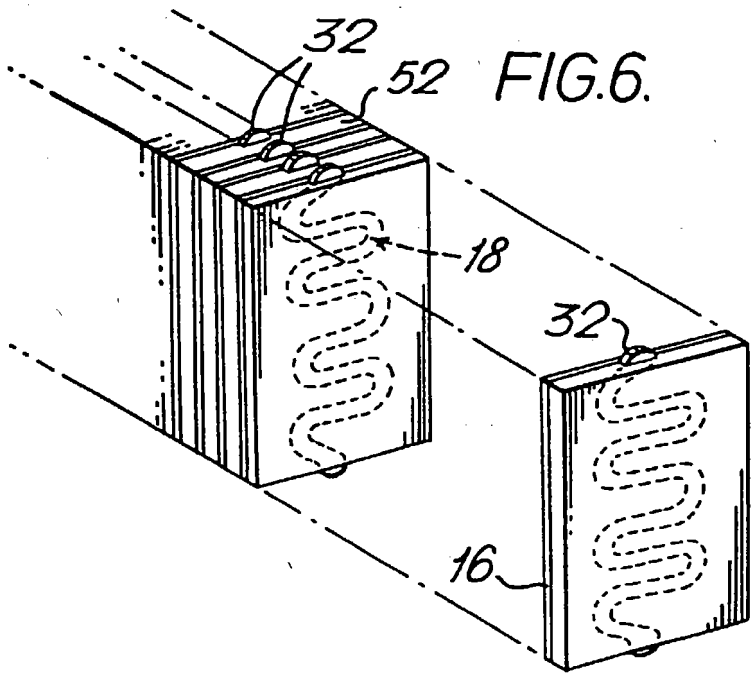


FIG.6.

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 79 30 2834.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 4 161 346 (G.B. CHERIAN et al.) * claims 1, 5, 6, 7; column 2, lines 3 to 8; column 2, lines 27 to 31; column 2, line 64 to column 3, line 10; fig. 1 and 3	1,5
	claim 1; fig. 1 and 3 *	2,6
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	US - A - 3 445 705 (F.E. FULLER et al.) * column 2, lines 59 to 66; fig. 7 and 8 *	2,6
	--	
	GB - A - 2 008 333 (AMP) * page 1, lines 84 to 104; fig. 2 and 3 *	1
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A	US - A - 4 029 375 (H. GABRIELIAN) * column 2, line 44 to column 3, line 21; fig. 1 and 2 *	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

H 01 R 23/72
H 01 R 23/70

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

H 01 R 23/68
H 01 R 23/70
H 01 R 23/72
H 01 R 39/40

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	23-07-1980	HAHN

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